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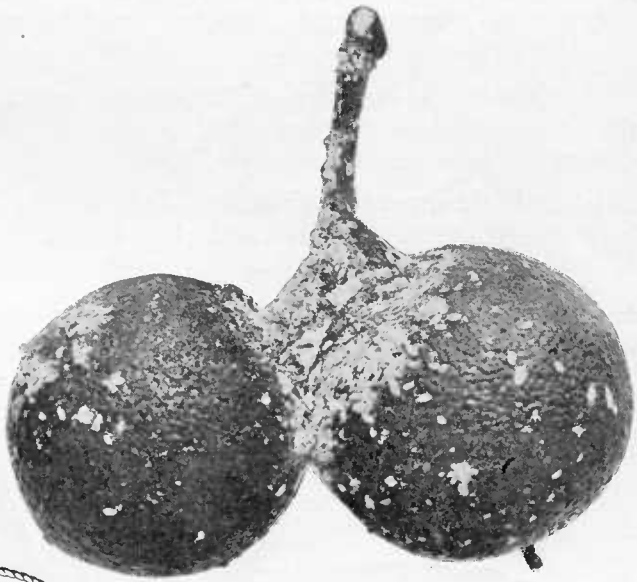
CONTROL *of the* COMMON MEALYBUG *on* CITRUS *in* CALIFORNIA



THE COMMON MEALYBUG is one of the more important citrus insect pests of California and in severe infestations causes serious damage to the foliage and fruit. It attacks all varieties of citrus, though the navel and Valencia oranges, grapefruit, and lemon are most seriously damaged. Heavy defoliation, fruit dropping, and a poor grade of fruit frequently result from the attack of this insect pest.

The control methods outlined in this bulletin include control by natural enemies and by spraying. The Argentine ant, where present, is an important hindrance to control, and attention must be given to it.

When the insect enemies of the mealybug are not present in sufficient numbers, the liberation of certain predators is recommended.

This bulletin supersedes Farmers' Bulletin 862, The Common Mealybug and Its Control in California.

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CONTROL OF THE COMMON MEALYBUG[1] ON CITRUS IN CALIFORNIA.

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INTRODUCTION.

FOR many years the common or "citrus" mealybug has been a menace to the citrus grower of California, and of necessity a great amount of attention has been paid to its control. At first, only occasional outbreaks were noted in widely separated localities, but in recent years the infestations have become more general and have extended over much wider territories.

These infestations, when severe, very seriously affect the appearance of an orchard and frequently cause a heavy loss in the fruit crop. Fortunately, however, this pest is frequently held down by its natural enemies and weather conditions to such an extent as to prevent serious damage.

In districts infested with the Argentine ant the mealybug has been noted to become much more severe and difficult to control. This is due to the relation this ant has to the natural enemies of the mealybug and to the pest itself. The ant now has a very wide distribution throughout citrus districts in the United States, which necessitates closer attention to its control.

The citrus grower can ill afford to permit the mealybug to become prevalent in his grove, especially when the ant is present, as even in a light infestation the loss in a season's crop will amount to much more than the cost of control.

DISTRIBUTION.

The common mealybug is of world-wide distribution and occurs on a large list of host plants. It has been reported as a citrus pest for more than 30 years in California, and frequently its control has

[1] *Pseudococcus citri* Risso.
[2] Resigned December 5, 1921.

been of serious concern. It is now reported from Ventura, Los Angeles, San Diego, Orange, and Santa Barbara Counties, where frequently, under favorable conditions, it becomes a serious pest.

The chief means of distribution of the pest is apparently through infested nursery stock, picking boxes, picking ladders and sacks, and the pickers' clothing, and by birds and insects. Picking boxes which have been used to transport infested fruit should be thoroughly treated before use in an uninfested orchard.

In many localities within the counties mentioned the infestations have been so completely eradicated by the methods given in this bulletin that the common mealybug is no longer reported as a pest in the citrus orchards.

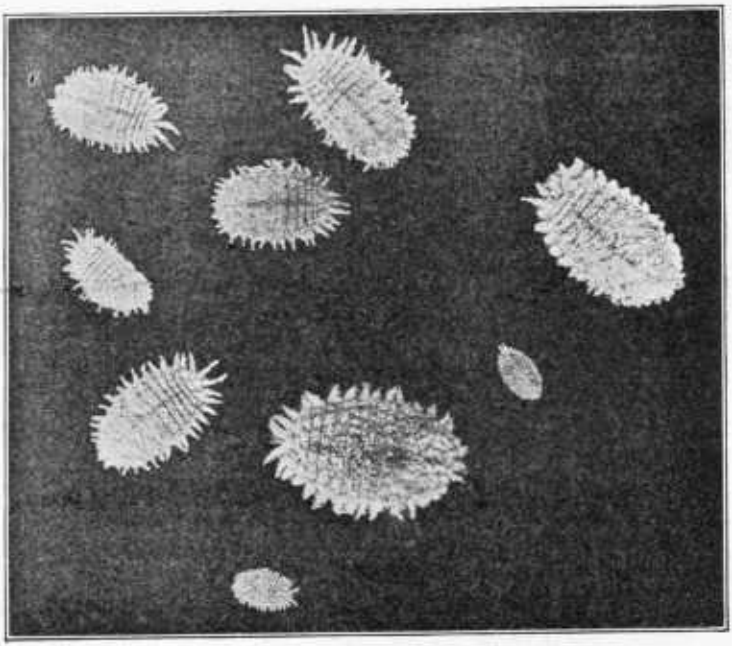

FIG. 1.—A group of common mealybugs. Enlarged about 9 times. (Woglum and Neuls.)

NATURE OF INJURY.

The common mealybug attacks the fruit, foliage, and twigs of citrus trees. Its feeding on the rind of the mature fruit causes serious discoloration and pitting, and its attack on the young fruit, especially under the sepals, materially weakens it and causes it to drop prematurely. The attack on the foliage and twigs may very greatly lower the vitality of the tree and even cause a severe defoliation.

In the honeydew secreted by this insect grows a black fungus, which is commonly termed "smut" or sooty mold, and the deposit of this on the fruit and foliage gives the tree a very unsightly appearance. Fruit covered with this sooty mold has to be washed in the packing house, which adds to the cost of handling.

In heavy infestations not only may severe defoliation occur, but a large percentage of the fruit may be lost by premature dropping. The loss in grade of the fruit is also very decided, and much of it may even be classed as "culls."

HOST PLANTS.

The common mealybug attacks all varieties of citrus, though the navel and Valencia oranges, grapefruit, and lemon are most seriously damaged. It possibly develops more readily on the lemon and grapefruit, though infestations on the oranges may be equally heavy. Its habit of collecting in the navel end of the orange makes it very difficult to dislodge. It also frequently gathers where two fruits touch, or in clusters of fruit, and forms large masses. During the reproduction periods large clusters of mature females with egg sacs may form on the fruit, limbs, or roughened places in the trunk. Fruit thus attacked is seriously discolored.

FIG. 2.—Lemon infested with the common mealybug. (Woglum and Neuls.)

CHARACTERISTICS AND LIFE HISTORY.

The general appearance of the maturing female is shown in Figure 1 and the infestation in Figure 2. The body of the female is covered with a white waxy secretion and the edge of the body is fringed with short waxy filaments. The adult female is similar in appearance to the immature form except in size and in the amount of waxy covering. The eggs are deposited in a white cottony mass secreted behind the mature female. The number of eggs deposited depends upon the size of the adult female and may range from 300 to 600 per individual. The length of a generation is from about seven weeks in summer to six months in winter, and there may be three or more generations in a year.

The immature male is similar to the immature female in the early stages, but in about four weeks forms a cocoon, and from this about two weeks later emerges a very small and delicate, winged gnatlike adult male. The life of the male is short.

The generations usually overlap so greatly during the winter months that they are difficult to distinguish, but with the warm weather of early summer a maximum infestation appears which may carry over well into the autumn. The seasonal history of the mealybug is difficult to follow on account of the overlapping of generations and the uneven development.

RELATION TO THE ARGENTINE ANT.

In the investigations of the Bureau of Entomology it has been found that the Argentine ant is a very important hindrance in the control of the citrus mealybug. The constant attendance of the ant (fig. 3) protects the mealybug from its natural enemies and results in its abnormal and often rapid increase. It has been definitely proved that the ant not only distributes the mealybug but also destroys the eggs and larvæ of certain natural enemies and by its constant attendance prevents the normal egg laying and feeding of the adult parasites and predatory enemies.

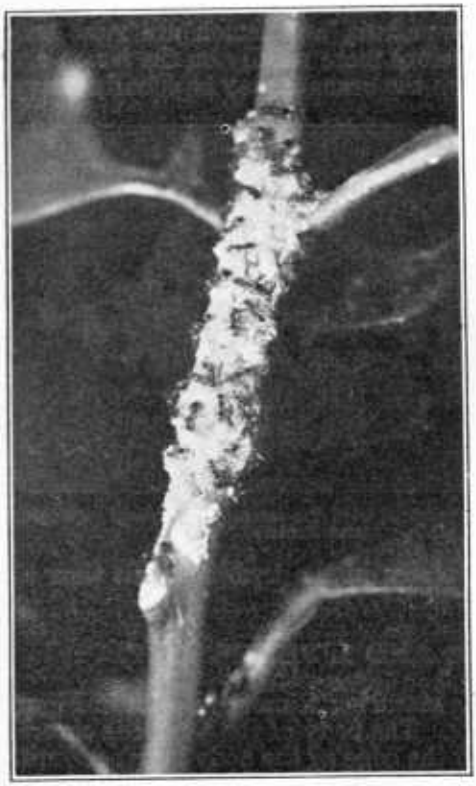

FIG. 3.—Ants attending a group of mealybugs. Their almost constant presence protects the mealybug from its natural enemies. (Woglum and Neuls.)

Remarkable results have been obtained in many citrus orchards by controlling the Argentine ant, thus permitting the natural enemies to breed freely. In fact, it is almost imperative, in order to obtain even commercial control of the mealybug, that the ant be eliminated or brought under control.

Ant-control methods.—The control of the Argentine ant has been carefully worked out and may be accomplished at a small cost. The method consists of distributing throughout the ant-infested area a poisoned sirup in a suitable container. This sirup is prepared from the following formula, preferably by a competent druggist, though it may be prepared at home provided clean equipment, accurate weighing, and proper materials are employed.

Formula and method of preparing ant sirup.

	Cost.
Water (11 pints)	$0.000
Tartaric acid (crystallized) (7 grams)	.016
Benzoate of soda (9 grams)	.029
Granulated sugar (12 pounds)	.84
Honey, strained (2 pounds)	.32
Sodium arsenite, C. P. (¾ ounce)	.047

Total sirup 2½ gallons, costing about 50 cents a gallon.

Put 10 pints of water in a clean vessel over a low fire. When tepid, add tartaric acid, then benzoate of soda, and then the sugar, slowly, while stirring to prevent burning. Measure the depth of the liquid with a stick. Slowly bring

it to a boil and allow it to simmer for from 30 to 40 minutes. Remove from the stove and add water to compensate for evaporation. Stir in the honey before the mixture cools. Then add sodium arsenite which has been dissolved in 1 pint of hot water and partially cooled before being poured into the sirup. Stir thoroughly.

It is necessary that great care be used in the selection of the materials as well as in the preparation of the sirup. The sodium arsenite should be chemically pure. The honey should be strained and free from comb. The sodium arsenite preferably should be dissolved in distilled water to avoid the precipitation which sometimes occurs if very hard water is used. Vessels should be thoroughly cleaned before being used for the preparation of ant sirup, and it is desirable that they be used for this purpose only. The stability of the sirup depends very much upon the way it is boiled. If brought to a boil within a few minutes and boiled vigorously for 30 minutes, the stability appears to be much less than if brought to a boil very slowly and then merely allowed to simmer for 30 or 40 minutes. Where several times the amount given in the formula is made in a large vessel, the sirup appears to "stand up" best. This seems to be due to the fact that the sirup does not come to a boil for an hour or longer, which probably results in greater inversion. The sirup should be used when fresh. Clean glass bottles are best if the sirup is to be stored.

FIG. 4.—A paraffined paper bag in place on tree. (Woglum and Neuls.)

The types of containers which have been successfully employed in applying the sirup include a quarter-pound paraffined paper bag (fig. 4), a 4-ounce paraffined spice can (fig. 5), and a 4-ounce paraffined pressed drinking cup. The paraffined spice can has proved most desirable, as it does not collect water and may be used over and over if properly cleaned and refilled. The paraffined bags

and cups are inexpensive, and if they do not leak are satisfactory after the rainy season or where water is not likely to reach them. Only paraffin having a high melting point (above 124° F.) should be employed in paraffining the cans or bags. Properly prepared for distribution, the approximate cost of the paraffined spice cans is 5 cents each; of the paraffined quarter-pound bags, 3 cents; and of the paraffined drinking cups, 1 cent.

In each container about 1½ liquid ounces of sirup is used. Four or five clean strands of excelsior about a foot long may be suspended very loosely from the top of the container (to serve as an attractive runway for the ants after entering) and the lid of the can replaced or the top of the bag folded over. The cans have a small hole (not over ¼ inch in diameter) punched near the top of one side before they are paraffined, and by this means each can is hung on a fourpenny finishing nail driven into the tree about a foot and a half from the ground over the ant trail. The ants travel up the trunk, out along the nail, and into the can through the hole in which the nail is inserted. The paper bags have from four to six holes punched about midway between the top and bottom and are completely immersed in melted paraffin, opened, and allowed to cool. They are placed the same distance from the ground as the cans and are fastened to the tree with an ordinary large carpet tack. A container should be attached to each tree in the orchard overrun with ants. The sirup should be renewed whenever it begins to harden or crystallize. An inspection at least once a month will determine the condition of the sirup and the feeding habits of the ants.

FIG. 5.—A paraffined spice can on tree trunk. (Woglum and Neuls.)

High temperatures, an excessive food supply, and favorable breeding conditions in the ant colony often increase the difficulty of ant control. Control is most quickly effected in the spring or autumn. Normally this will be from the time the ants first become

active in the spring until July 1 and from the last of September until the ants again become inactive with the approach of cold weather.

CONTROL METHODS.

FUMIGATION INEFFECTIVE.

Fumigation as practiced in the citrus orchards of California for the control of other citrus pests is ineffective as a means of control of the citrus mealybug. A dosage of over an ounce of cyanid per 100 cubic feet of space in an airtight inclosure would be required to destroy this insect—a dosage which the trees would not endure.

NATURAL CONTROL.

None of the important citrus insect pests in California is more effectively preyed upon by its natural enemies[3] than the citrus mealybug. If the Argentine ant is not present and the enemies of the mealybug are present in sufficient numbers, they will clean up an infestation and hold it in commercial control over a long period.

It is very important first to control the ant by the methods already outlined. The predators and parasites will then increase in numbers and under proper conditions will effect a control.

The distribution of additional predators such as the lacewing flies and the ladybird beetles from the State and county insectaries is highly recommended. This distribution should be made during the spring and autumn months and should follow closely the ant-control work.

SPRAYING CONTROL.

Only in severe infestations is control by spraying necessary. In this work it is desirable to have all fruit removed and the trees pruned so as to permit "open" spraying. A power sprayer carrying at least 350 pounds pressure with spray guns having an $\frac{8}{64}$-inch disk opening are most desirable. Much inside spraying of the trunk and main limbs will be found necessary as well as a thorough application to the outer foliage. Too much importance can not be given to the thoroughness of application or to maintaining a driving mist spray under high pressure.

Mealybug infestations occur largely on the inside of the tree, and it is important that this part receive especial attention from several positions, preferably before the outside of the tree is sprayed. Spraying may be done to the best advantage in the late autumn and winter months. Either of the following insecticides is recommended:

Miscible oils.—A good commercial miscible oil used at the rate of 3 gallons to each 100 gallons of water in the spray tank is not only the most convenient but the safest insecticide to employ. It eliminates the danger of injury from free oil and the possible caustic effect of the soap powder contained in the cresol-soap-distillate emulsion.

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[3] The more effective enemies of this species, including both predators and parasites, given in the order of their importance, are: *Symplierobius barberi* Banks, *S. californicus* Banks, *Hyperaspis lateralis* Muls., *Cryptolaemus montrouzieri* Muls., *Chrysopa californica* Banks, *Leucopis bella* Loew, and *Paraleptomastix abnormis* Girault.

Cresol-soap-distillate emulsion.—A cresol-soap-distillate emulsion may be prepared from the following formula:

Distillate (28° Baumé)	gallons	2½
Liquor cresolis compositus	quarts	1½
Soap powder	pounds	3
Water	gallons	100

Preparation.—(1) When the water in the bottom of the spray tank covers the agitator rod, start the agitator and slowly sift in the soap powder. (2) Add the liquor cresolis compositus to the distillate and stir well. (3) Add the mixture of liquor cresolis compositus and distillate to the soap mixture in the tank and fill the tank with water.

The grade of the distillate and the soap powder used is very important. The distillate should test approximately 28° Baumé and be fairly free from impurities. Certain grades of commercial soap powders emulsify more readily than others, and as the oil is largely held in solution by mechanical agitation it is important to obtain good ingredients. The resulting spray solution in the spray tank should be milky white and free from scum and free oil.

SUMMARY.

The common or "citrus" mealybug seriously affects the fruit of oranges, lemons, and grapefruit. It not only causes premature dropping of the fruit but materially lowers the grade. Heavy defoliation and lowered vitality of the trees frequently follow an infestation.

The Argentine ant bears an important relation to the control of the mealybug and may be controlled by the use of poisoned sirup.

The mealybug is largely controlled by its natural enemies, and with the liberation of certain predators may be effectively controlled.

In severe infestations spray-control methods herein given have proved very effective.